

Push-button

Engineering manpower at Avro Aircraft Ltd. of Malton has been increased by 3,000! No mean feat in an industry where shortage of trained engineers is a constant headache.

It's not literally true! But it's one yardstick against which to measure importance of completion last month on the in-plant installation at Avro of an IBM 704 electronic data processing system.

The 704 is described as the latest and most powerful digital computer available to industry for scientific applications. Its computation capacity is said to be equivalent in calculating

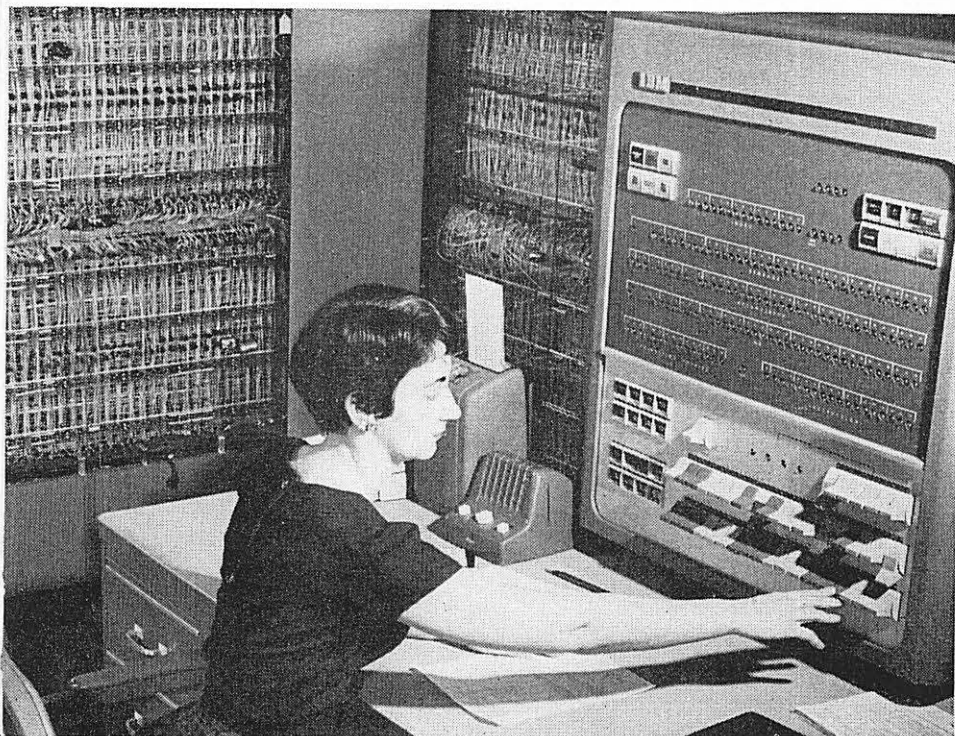
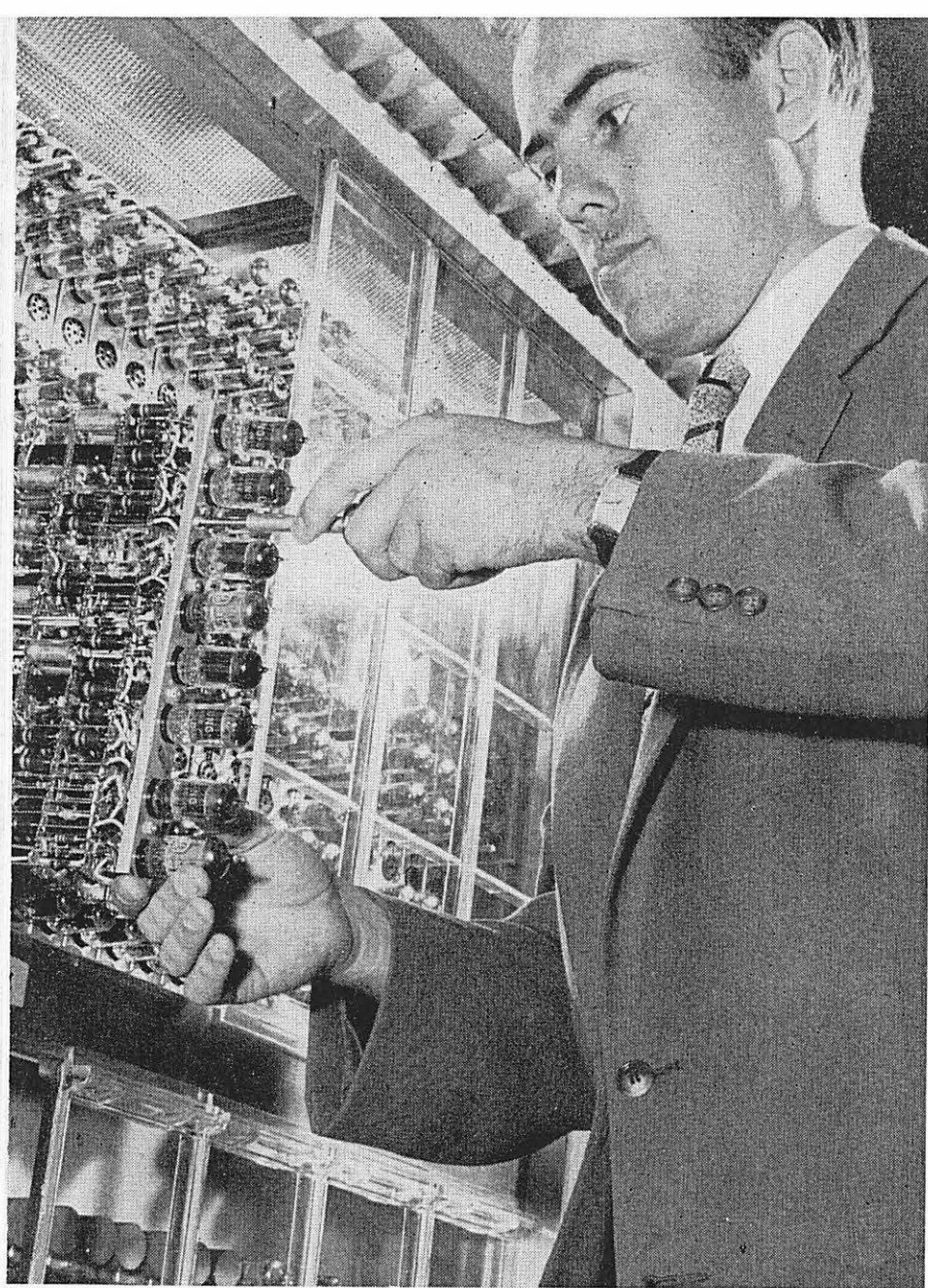
PICTURES SHOW

LEFT: There are 4,000 of these tubes in the 704 computer. For ease of maintenance they can be removed in sectional units as illustrated.

BELOW LEFT: Console of the computer. This gives the operator the equivalent of 3,000 mathematicians at her fingertips.

CENTRE: The power distribution unit. Controls current and voltages to the components of the 704 to extremely close tolerances.

RIGHT: Cabinets at the left of the picture are used for testing of the tape units under simulated working conditions.



Engineering for the Avro CF-105

Electronic brain aids in grooming the arrow for flight

and problem solving capacity to 3,000 fully trained engineers.

Avro's major immediate use of the 704 is in connection with final preparations for this year's maiden flight of the delta-wing Arrow. The supersonic, all-weather interceptor, developed by Avro as the successor to the CF-100, is widely regarded as the most advanced aircraft of its type coming off drawing boards throughout the world.

Arrow Program

Some typical problems on which the 704 can assist Avro's Arrow engineering team include: trans-sonic and supersonic wave drag computation, flutter and vibration studies, stability in various flight conditions, dynamic and structural response to controls, air load and lift coefficient distribution, stress, the deflection analysis of components, systems design (fuel, armament, air-conditioning, electrical . . .), wind tunnel and free flight model data reduction, flight test data calibration and processing.

On the latter operation (flight test data calibration and processing) it is possible to arrange a system whereby data could be telemetered from the prototype in flight to feed directly into the 704 for processing. This means that the computer could be providing engineers with answers on performance, and airframe and component

functioning within minutes or in some cases seconds of the aircraft being subjected to the flight condition under study.

Avro engineers are said to be giving serious consideration to incorporating such a telemetering system for use in the Arrow flight test program.

Among the chief advantages claimed for the 704 by IBM representatives is the high speed at which it attacks and solves a variety of engineering problems.

The computer can execute 70% of its internal operations at the rate of 41,700 per second. It can make about 10,000 arithmetical operations a second while automatically keeping track of the decimal point. In a single second, it can perform 40,000 additions or subtractions, or 5,000 multiplications or divisions of 10-digit numbers.

Frees Technicians

Avro's Vice-President Engineering, J. C. Floyd sees "the speed and capacity of this computer freeing engineers and key technicians from a mass of repetitive work so they can spend more time on creative design problems."

In 22 seconds, he points out, the 704 can solve 30 simultaneous equations involving 54,000 multiplications and the same number of additions. Doing the same job with a desk-type

computer, he continues, an engineer working at top speed and with complete accuracy would have to work 24 hours a day for 13 days.

Memory" Key

At the heart of the 704's high operating speed is a magnetic core "memory" system for the storage of program and random data. The magnetic core's capacity is 4,096 "computer words"—that is combinations of characters with unit meaning. Each "word" can be made up of just over a 10-decimal digit number, or combinations of numbers and letters.

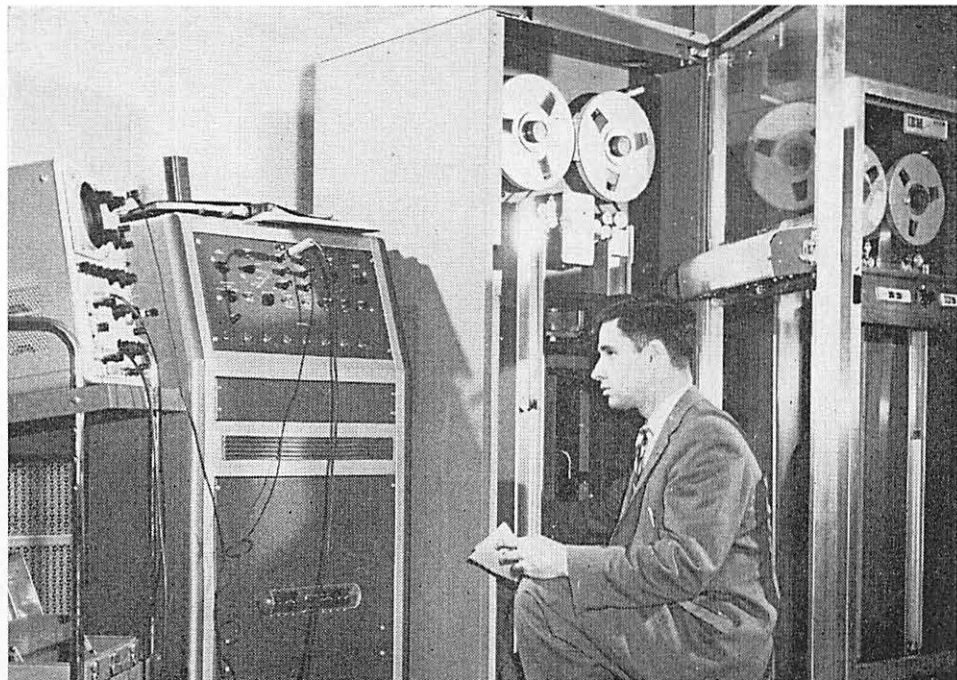
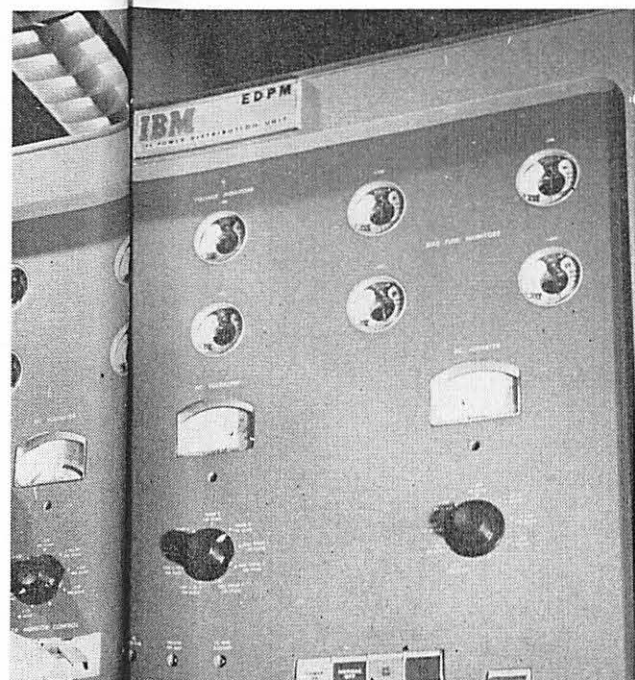
To achieve this capacity, the memory array is composed of 147,456 individual magnetic cores, each retaining a key polarity.

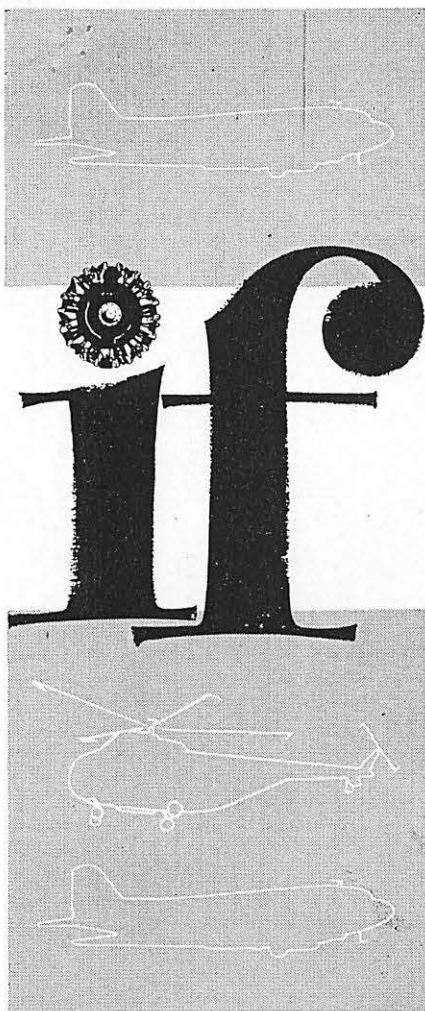
This magnetic core system, IBM engineers say, is what gives the 704 its speed advantage. Other computers could process data and execute operations at speeds comparable to the 704, if the data were made available to them fast enough. But comparatively slow availability of stored data is the limiting factor on their speed of operation.

Access time to information stored in the 704's magnetic core memory is one 12 millionth of a second. This is the fastest system in commercial use today.

In addition to the high-speed mag-

(Continued on page 92)





IF you have anything to do with airplanes or helicopters, then you probably have something to do with Engines... AND IF you have anything to do with Engines, you *SHOULD* have something to do with *DALLAS AIRMOTIVE*.

Member National Business
Aircraft Association



Home of Reliable Engines



6114 FOREST PARK ROAD
FLEETWOOD 1-3771 • DALLAS, TEXAS
Washington Office: New York Office:
Woodward Building 1219 Marine Terminal Bldg.
733 15th Street, N.W. La Guardia Station
Washington, D.C. Flushing 71, N. Y.

Avro 704 Computer

(Continued from page 43)



704 LAYOUT. General view of the central area of the 704 computer. Console is at the right, printer output unit is in the foreground, and tape units at the rear.

netic core storage unit, the 704 as installed at Avro, has four magnetic tape storage units which together can accommodate close to 4,000,000 10-digit numbers or the same number of words or combinations. This is approximately equivalent to the white page listings of three metropolitan telephone directories.

Capacity of 704 can be readily expanded by the addition of further magnetic core, tape or drum storage units.

In its present form at Avro, the 704's units are packed with upwards of 25 miles of wire, over 4,000 electronic tubes and 13,000 germanium diodes.

The various machines are linked by a central "brain" which draws power and information from them and directs the work.

Program information can be fed into the system by punched cards (250 cards a minute equivalent to 100 "words" a second), or magnetic tape (75 inches or 2,500 words per second).

Information can be drawn from the computer on punched cards (100 cards a minute); magnetic tape (75 inches per second); or from a printer (150 lines a minute).

Reduces Unknowns

In a further evaluation of the 704's

application to Avro needs, Vice-President Engineering Floyd says his staff will now be able to ascertain several factors about the Arrow which a few years ago could not have been learned prior to actual flight. Thousands of mathematicians would have been required to do the job.

Using the computer for mathematical confirmation of engineering theories and calculations, he says, will considerably reduce the number of unknowns when the Arrow prototype takes to the air.

Application of the 704's capabilities to data reduction during the flight test program itself was touched on earlier.

Floyd's comments in this regard do not indicate any concrete plans for direct telemetering from the prototype to the 704. However, he does point out that "detailed characteristics of the project while in flight, pour in considerable quantity into the ground auxiliary equipment now in operation at Avro.

"From here this mass of flight information can be fed into the 704 for quick reduction to a workable form for engineering analysis."

In this way, he concludes, it is possible to learn more quickly and accurately what is actually happening when a project goes through manoeuvres at certain speeds. Information which

is invaluable for development work.

Indicative of the extensive use to which Avro will put the 704 in its Arrow prototype testing and other problems is the fact that it is expected that within a year the facility will be operating 24 hours a day as compared with the current work load of nine hours a day.

The cost of equipment in the 704 installation at Avro is just \$1,500,000. The aircraft company has not purchased the computer facility, but is leasing it at a rental of \$27,000 a month.

The system is housed in a specially constructed temperature and humidity controlled room, serviced by a 250 kilowatt generator, a 50-ton air conditioner and an electrostatic dust filtering system. It was built at a cost of about \$100,000.

First Canadian 704

The computer facility staff is made up of 30 highly trained operators and technicians headed by 29-year-old Art Downing, Avro's Chief of Digital Computing.

The Malton system is the first installation of an IBM 704 outside of the United States. The computer is the same as that which is to be used this year to calculate and predict the orbit of the earth satellite which is to be launched by the United States as a part of its contribution to the International Geophysical Year.

There are at present about 50 other IBM 704 facilities installed in the United States, a number of them being used by the aviation industry there.

3 NORSEMEN

ALL EXCELLENT CONDITION

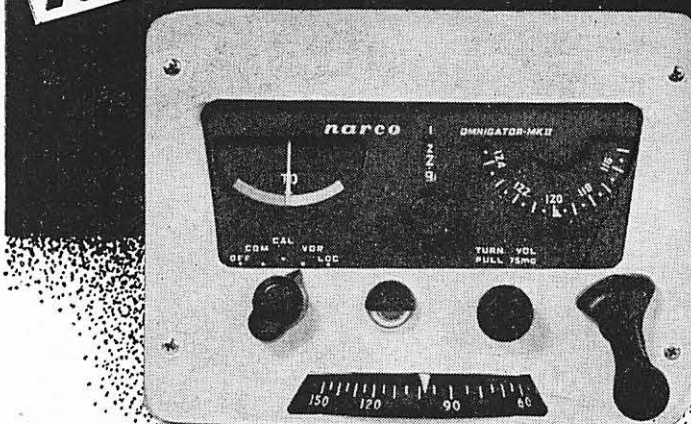
MAKE YOUR CHOICE
FROM FLEET OF 12
WHEELS, SKIS, FLOATS
RADIO, NEW C OF A

Write, Wire or Phone

**ONTARIO
CENTRAL
AIRLINES**
KENORA, ONT.

Announcing . . . the New

narco OMNIGATOR MARK II



More channels, increased transmitting power, tripled band width, whistle-stop tuning, increased speaker output—all these up-to-date features plus many others are offered in the sensational new Omnigator Mark II. Printed circuits plus the most advanced electronic refinements make all this added performance possible in the same compact single-package navigation and communications unit which has made the Omnigator the most popular, the most respected, the most accurate (proved by government test) of all popular business-plane Omnis.

NOW

with 27 Channels

**NO OTHER RADIO GIVES YOU SO MUCH
IN A SINGLE, COMPACT UNIT**

27 CHANNELS give you ample crystal capacity for all normal communications—VFR or IFR.

**TRANSMITTER POWER INCREASED;
BAND WIDTH TRIPLED.**

DOUBLED AUDIO OUTPUT.

SUPER ACCURATE VOR navigation. Factory-certified to be accurate within 2 degrees.

LARGE SCALE COURSE SELECTOR permits accurate course selection to the exact degree.

IMPROVED COURSE INDICATOR with ideal sensitivity, combined with new type To-From indicator.

ILS LOCALIZER reception for instrument approaches.

75 Mc MARKER BEACON RECEIVER.

VHF RECEIVER 108 to 127 mc for crystal clear reception.

Plus

**BUILT-IN
WHISTLE-STOP
TUNING!**

Pioneered by Narco four years ago, tunes your receiver precisely, positively to your transmitter frequency for simplex communications with towers, control centers, Unicom.

*For brochures
on NARCO products,
please write—*

Marconi



CANADIAN MARCONI

COMPANY — MONTREAL, QUEBEC

AVIATION DEPARTMENT
970 McEACHRAN AVE.,

Distributor of NARCO products in Canada